

226. The process according to Claim 222 wherein C₇₀ is additionally present in the sooty carbon product.

227. The process according to Claim 222 wherein C₇₀ is additionally present in the sooty carbon product and is additionally separated from the sooty carbon product and is present in the crystalline C₆₀.

228. The process according to Claim 227 wherein the C₇₀ is separated from the crystalline C₆₀.

229. The process according to Claim 222 wherein the crystalline C₆₀ is substantially pure crystalline C₆₀.

230. A process for preparing C₆₀ comprising vaporizing ^{elemental} ~~a carbon source~~ selected from the group consisting of graphite, amorphous carbon and glassy carbon in an inert quenching gas at a pressure of at least 50 torr so as to generate a carbon soot comprising C₆₀ and separating said C₆₀ from said soot under conditions effective to recover substantially pure crystalline C₆₀ therefrom.

231. The process according to Claim 230 wherein the pressure ranges from about 50 torr to about 400 torr.

REMARKS

The Office Action has rejected Claims 45-84, 96 and 160-203 under 35 U.S.C. §112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regard as the invention. Claims 45-84, 96 and 160-203 are rejected under 35 U.S.C. §112, first paragraph, as allegedly being non-enabling and allegedly failing to describe the invention that is being claimed. Moreover, Claims 45-46, 50-51, 55-58, 66, 68-71, 73-74, 83-84, 160-168, 171-175, 177-178, 181-191 and 195-202 are rejected under 35 U.S.C. §102 (b) as allegedly

defining subject matter which is anticipated by the teachings in Huffman, et al. in Nature Physical Science 1973, 243, 50-51 ("Huffman, et al.") with an article by Iijima in J. Phys. Chem., 1987, 91, 3466-3467 ("Iijima") being cited to allegedly show inherent states of fact. Furthermore, Claims 45-84, 96 and 160-203 are rejected under 35 U.S.C. §103 as defining subject matter which is allegedly rendered obvious by the teachings in Huffman et al. in view of Iijima and Russian Patent SO 1,587,000 ("Russian Patent"). Claims 45-54, 57, 62, 63, 76-80, 83-84, 160-163, 169, 179, 180-183, 187-188, 192-193 and 203 are rejected under 35 U.S.C. §103 as defining subject matter which is allegedly rendered obvious by U.S. Patent No. 4, 808,395 to Yoshimura in view of U.S. Patent No. 4,435,378 to Reck ("Reck"), with an article by Shigematsu in Idemitsu Tokuhō ("Japanese article") cited to show inherent states of fact. Claims 45-46, (68-71)/45, (73-74)/45, 83, 160-163, (167-168)/163, 172-175, 177-178, 181-191, and 195-202 are rejected under 35 U.S.C. §102 as allegedly being anticipated by U.S. Patent No. 2,957,756 to Bacon ("Bacon"). Finally, Claims 45-46, 50-51, 58, 66, 68-75, 83-84, 160-163, 171-178, 181-191, 195-202 are rejected under 35 U.S.C. §102(b) as allegedly being anticipated by an article by Kappler, et al. in J. App. Phys. 1979, 50, 308-316 (Kappler, et al.)

In response thereto, applicants have amended the claims, which, when considered with the comments hereinbelow, are deemed to place the case in condition for allowance. Favorable consideration is respectfully requested.

At the outset, applicants wish to thank Examiner DiMauro for meeting with applicants' representative and for the courtesy and kindness extended thereto. Applicants appreciate

Examiner DiMauro's efforts in trying to resolve the outstanding issues, and have presented some claims along the lines discussed in the interview.

Claim 45, 46, 50, 51, 52, 58, 62, 63, 64, 83, 84, 160, 163, 165, 169, 170, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 192, 193 and 203 have been amended by specifying that the product, whether C₆₀ or other fullerene, is extracted from the sooty carbon product. Support is found throughout the specification, see e.g., Page 5, Line 7 to Page 6, Line 6 of the instant specification. This language in the claim connotes separation of the product from the soot. Claim 50 was amended to connote that the collecting surface is remote from the site of vaporization. Support thereof is found on Page 5, Lines 10-15 of the instant specification. Claim 50 also recites that the C₆₀ is recovered in macroscopic amounts. Support is found throughout the specification, as described hereinbelow. Claim 171 was amended to recite that the vaporization occurs in a vessel which had previously been evacuated. Support thereof is found on Page 6, Line 23 to Page 7, Line 10 of the instant application.

Claims 83 and 84 have been amended to recite that the recovered C₆₀ is in amounts sufficient to form a visibly colored solution when extracted with benzene. Support is found on Page 7, Lines 10-11 and in Example 1, Lines 18-20 of the instant specification.

Applicants have added Claims 204-231 which are directed to additional embodiments of the present invention. In fact, Claim 230 is the claim that was suggested by the Examiner at the interview. More specifically, Claims 204-212 and 222-231 recite the process for producing C₆₀ as a function

of its pressure. As described in the instant specification, the pressure of the quenching inert gas that is effective in producing C₆₀ is less than 1 atmosphere, and preferably at least 50 torr. (See Page 13, Lines 26-31 and Page 11, Lines 22-29 of the instant specification). At these pressures, the C₆₀ is produced in such quantities that actual crystals of C₆₀, and even powdered C₆₀ are collected. (See, e.g., Page 7, Lines 11-15, Page 8, Lines 6-24, Page 9, Line 3, Page 11, Lines 22-29, and Page 16, Lines 22-27 of the instant specification). In fact, the C₆₀ product formed is present in such amounts that a color is perceived. (See, e.g., Page 7, Lines 10-25, Page 8, Lines 10-16, and Example 1 on Page 10, Lines 22-27 of the instant specification).

Claims 213-221 emphasize that the process of producing C₆₀ in accordance with the present process generates amounts of C₆₀ sufficient to perceive as a solid (powder, crystals etc.). As indicated hereinbelow, no one heretofore was successful in making C₆₀ in such quantities. Support for these claims is found throughout the instant specification, e.g., Page 7, Lines 11-15, Page 8, Lines 6-24, Page 9, Line 33, Page 11, Lines 22-29).

No new matter has been added to the application.

Applicants respectfully submit that the claims, as recited, clearly define the metes and bounds of the invention. However, the Office Action has improperly rejected the claims under 35 U.S.C. §112, second paragraph. Instead of reading the claims as a whole, as required by law, the Office Action has raised issues with individual terms taken out of context.

For instance, Claims 160 and 181 recite that such appreciable amounts of fullerene, e.g., C₆₀, is present in both

the soot and in the extract from the soot in such amounts that it can be seen with the human eye. The claims connote this amount in functional language by reciting that the fullerene (e.g., C₆₀) is present in amounts capable of extracting fullerene (e.g., C₆₀) from the soot in solid form and that it is recovered as a solid. Applicants submit that the presence or absence of sufficient material to be visible as a solid is a characteristic that is easily determinable.

However, the Office Action alleges that such a limitation is indefinite, and specifically asks "... if ... a microgram of C₆₀ was an amount needed to qualify as solid C₆₀, would a process which produced a kilogram of soot which in toto contained microgram of C₆₀, ... be within the claims...?" In addition, the Office Action raises the question, "what is the lower limit?" First, case law has held that lower limits need not be recited to comply with 35 U.S.C. §112, second paragraph. See, In re Kirsch, 498 F.2d 1389, 1393-1394, 182 U.S.P.Q. 286, 290, (CCPA 1974). But more importantly, how can anything be more definite than visible versus not visible? From the beginning of time, man has relied upon his senses to determine if something is present, hence the adage "seeing is believing". The amount of fullerene (e.g., C₆₀) produced by the process of the present invention is in macroscopic amounts, amounts which are definitely discernible by the human eye. Thus, there is no indefiniteness in the amount product.

The same comments apply to the rejection of Claims 83 and 84 wherein it is recited that the product is formed in amounts sufficient to be capable of forming a colored solution when dissolved in benzene. Again, the Office Action takes the position that something which is definite within the meaning of

35 U.S.C. §112, second paragraph is indefinite. These claims again recite another test of whether appreciable amounts of fullerene, e.g., C₆₀, is formed. If the benzene solution remains uncolored when fullerene (C₆₀) is placed into sufficient benzene to dissolve the fullerene (C₆₀) then insufficient amounts of product are generated. The U.S.P.T.O. raises the issue that this is indefinite, alleging that visual acuity varies from person to person; however, the test is color versus no color, i.e., something which is easily determinable and discernible, and which is an objective rather than subjective standard.

In both situations, the U.S.P.T.O. has failed to consider the history regarding fullerenes. Heretofore, no one had generated enough fullerenes such as C₆₀, to be seen with the naked eye or as indicated in Curl, et al., in Scientific American, 1991, Page 55, when dissolved in benzene produced a colored solution. However, the methodology of the present process produces such appreciable amounts of fullerenes, e.g., C₆₀ that it can be visibly seen or forms a colored solution when the entire product produced is placed into benzene. Not only does this distinguish over the prior art, but as indicated hereinabove both are simple tests to easily ascertain whether the requisite amount of product is produced.

The U.S.P.T.O. also alleges that the term "caged molecule" in Claim 160 is indefinite and questions whether such terminology refers to molecules within clathrates of hydrogen bonded water". Again, the Office Action reads this terminology out of context and again the U.S.P.T.O. has failed to read the claims as a whole. From the language of the claim, it is clear that caged molecules refers to an allotrope containing only

carbon atoms. No water molecules are, by definition, present. Moreover, this terminology is readily understood by the skilled artisan. In the parlance of the skilled artisan this term "caged molecule" is synonymous with fullerenes. Thus, there is no ambiguity as to the meaning of said claim.

The Office Action objects to the term "recovered", alleging that such term is indefinite. However, this term has legal significance as it is widely used in Claim language. However, in order to advance the prosecution, applicants have amended the claims to recite that the product is "extracted" from the soot. This connotes separation of the fullerene product, such as C_{60} , from the soot.

With respect to Claim 58, the Office Action alleges that it is unclear whether C_{70} which is present in the soot is separated from the C_{60} . The separation of C_{60} from C_{70} is recited in Claim 59. Claim 58 only requires that C_{70} is extracted from the soot. Again, the metes and bounds thereof are sufficiently understood to the skilled artisan.

These rejections and rationale in support thereof discussed hereinabove are therefore totally unjustified and without any merit.

With respect to the rejections to claims 55 and 171, applicants submit that the amendment to the claims overcomes the Examiner's rejection. In claim 171, as indicated hereinabove, the claims recite that the vaporization of the carbon source occurs in a vessel which had previously been evacuated. Claim 55 recites that the extracted material from the soot is a crystalline solid.

Thus, for the reasons provided, the rejection of the claimed subject matter under 35 U.S.C. §112, second paragraph, is obviated, and withdrawal thereof is respectfully requested.

The Office Action has rejected the claimed subject matter under 35 U.S.C. §112, first paragraph, for allegedly failing to describe the invention claimed and for allegedly being non-enabling.

More specifically, the Office Action alleges that the specification does not describe fullerenes or caged molecules comprised solely of carbon. Applicants strongly disagree.

Applicants submit that there is ample support in the specification for the term "fullerene". This concept permeates the instant specification. For instance, the application specifically discusses C_{60} , C_{70} and C_{240} . Each of these molecules is a fullerene. See ¶16 of Kroto Declaration and Exhibit 6 attached thereto. C_{60} is fullerene-60, C_{70} is fullerene-70 and C_{240} is fullerene-240. The application also refers to an allotrope of carbon (e.g., see Claim 27, and Page 16, Line 26 of the instant application), compounds made of solely carbon atoms soluble in non-polar organic solvents (e.g., see Page 3, Line 30 to Page 6, Line 6), soccer ball and carbon caged compounds made solely of carbon atoms (see, e.g., Page 11, Lines 8-11 of the instant specification), all of which are descriptions and characterizations of forms of fullerenes. The whole thrust of the application is directed to a new form of carbon. In fact, the application is so titled. Furthermore, Kroto in his Declaration, attests that the application describes fullerenes to the skilled artisan; attention is directed to Paragraph 15 of the Kroto Declaration wherein he states:

In my professional judgement, the above-identified application adequately teaches to the skilled artisan how to make macroscopic amounts of fullerene, including C_{60} and C_{70} ; furthermore, there is ample evidence in the application that Huffman and Kratschmer had in their possession macroscopic amounts of these products.

The other terms, such as "caged molecules consisting solely of carbon atoms", "carbon allotrope", etc. are accepted but different descriptions of fullerenes. The terms used in the claims are within the accepted jargon of the scientific community.

Moreover, contrary to the allegations, the application has a written description of caged molecules. As the Office Action admits, both C_{60} and C_{70} are described therein as caged molecules. Furthermore, C_{240} is depicted as a caged molecule (See Page 11, Lines 15-21). Thus, this represents a recognition by the inventors that the new form of carbon, i.e., the fullerenes, can be depicted as caged molecules.

Even the Office Action admits that the application describes C_{60} and C_{70} as caged molecules containing only carbon atoms. See Page 8 of Official Action. With this admission, it is incongruous for the Official Action to also allege that there is no description of fullerenes in the application.

Thus, there is implicit support for these concepts and terms in the application upon which to base generic claim language. See, In re Robins, 429 F.2d 452, 166 USPQ 550 (CCPA 1970).

Contrary to the allegations in the Office Action, the present situation is not unlike that in In re Smythe, 480 F.2d 1376, 178 USPQ 279 (CCPA 1973). In Smythe, the invention

related to a "continuous automatic analysis system where discrete liquid samples...are successfully introduced into an apparatus as a continuous stream, the individual samples being separated by a segmentizing medium." Both the specification and original claims identified this medium as "air or other gas which is inert to the liquid." The applicant later added claims that described the medium as "inert fluid". The USPTO rejected the added claims on the basis of the description requirement, but the Smythe Court reversed, stating that the use of the term "inert fluid" would naturally occur to the skilled art reading the description of the use of air or other gas as a segmenting medium to separate the liquid samples. Id at 1384, 178 USPQ at 285. The court provided its rationale as follows:

....[W]hereas the broader concept of using "inert fluid" would naturally occur to one skilled in the art from reading appellants' description of the use and functions of the segmenting medium specifically described, we see no basis for denying appellants the claims which recite the segmenting medium broadly as "an inert fluid". The alternative places upon patent applicants, the Patent Office, and the public the undue burden of listing, in the case of applicants, reading and examining, in the case of the Patent Office, and printing and storing, in the case of the public, descriptions of the very many structural or functional equivalents of disclosed elements or steps which are already stored in the minds of those skilled in the arts, ready for instant recall upon reading the descriptions of specific elements of steps.

We are not saying that the disclosure of 'air or other gas which is inert to the liquid' sample by itself is a description of the use of all 'inert fluid' media. Rather, it is the description of the properties and functions of the 'air or other gas' segmentizing medium described in appellants' specification which would suggest to a person skilled in the art that appellants' invention includes the use of 'inert fluid' broadly...

A hypothetical situation may make our point clear. If the original specification of a patent application on the scales of justice disclosed only a 1-pound 'lead weight' as a counterbalance to determine the weight of a pound of flesh, we do not believe the applicant should be prevented, by the so-called 'description requirement' of the first paragraph of §112, or the prohibition against new matter of §132, from later claiming the counterbalance as a 'metal weight' or simply as a 1-pound 'weight', although both 'metal weight' and 'weight' would indeed be progressively broader than 'lead weight', including even such an undisclosed, but obviously art-recognized equivalent, 'weight' as a pound of feathers. The broader claim language would be permitted because the description of the use and function of the lead weight as a scale counterbalance in the whole disclosure would immediately convey to any person skilled in the scale art the knowledge that the applicant invented a scale with a 1-pound counterbalance weight, regardless of its composition. (Emphasis in original)

Applicants submit that the Office Action has misinterpreted the decision. It is not based upon the term "inert fluid" being equivalent to "air or other gas which is inert to the liquid", as the Office Action alleges, since the former term is broader than the latter. The Smythe Court held that the description in the application suggested to the skilled artisan the broader term. Similarly, as in Smythe, the present application supports the broader concept, fullerenes. It is the description of the properties with the concomitant characterizations of the C₆₀, C₇₀, etc., in the application that connotes to the skilled artisan the broader concept of fullerenes.

The present application cannot be considered in a void, but again must be placed in the proper historical perspective. Prior to the filing of the application, the existence alleotropes of carbon, fullerenes, was speculative. They were believed to be caged molecules from theoretical calculations, however, no one, until the present inventors, made it in sufficient quantities, was able to verify the theory. Thus, these terms "caged molecules," "alleotropes of carbon" etc. have historical significance connoting meaning to the skilled artisan at the time of filing.

Applicants respectfully submit that the Office Action has applied an incorrect standard to the description requirement. Case law has held that satisfaction of the description requirement requires that the disclosure of the application conveys to the skilled artisan that the inventor had possession at the time of filing of the application of the claimed subject matter. Vas-Cath Inc. v. Mahurkar, 935 F.2d 1555, 19 USPQ 2d 1111 (Fed. Cir. 1991). The usage of the terms

"allotropes", "caged molecules of carbon", "new form of carbon", are terms interchangeably used for fullerenes and demonstrate that applicants had in their possession "fullerenes". The application describes C₆₀, C₇₀, and C₂₄₀, which are three species of the genus, which further supports that applicants had possession of the invention at the time of filing the invention. Contrary to the allegations in the Office Action, these three species, when taken together with the other descriptions in the application in the context of the historical perspective, support the genus.

Moreover, the Kroto Declaration, which was filed with the previous Response further supports that applicants had possession of fullerenes at the time of the filing of the application. Kroto avers in paragraph 15, that there is sufficient evidence in the application that the inventors had in their possession fullerenes at the time of filing the application. Thus, the U.S.P.T.O. conclusion that the disclosure does not reasonably convey to the skilled artisan that applicants had possession of fullerenes is not only contrary to the evidence, but also is without any merit.

Similarly, there is adequate support in the application for the term "macroscopic". Support for this term and concept permeate the specification. For example, attention is directed to Page 7, Lines 10-25, Page 8, Lines 3-16 and to Example 1 of the instant specification wherein the color of the product produced therefrom is indicated to be seen with the naked eye. Obviously, one cannot determine color with the naked eye unless it is present in amounts that can be seen with the naked eye, i.e., macroscopic amounts. If less than macroscopic amounts were produced, no color would be seen even

if the samples were dissolved in benzene. See, Curl, et al, Scientific American 1991, 54-55. Furthermore, attention is directed to Figure 2, of the instant specification wherein an X-ray diffraction pattern is provided of a product produced in accordance with the present invention. As the skilled artisan is well aware, macroscopic quantities had to be available to generate a X-ray diffraction of the product. In addition, attention is directed to Page 11, Line 30 of the instant specification wherein it is indicated that the IR is taken of an approximately two micrometer thick C_{60} coating on a silicon substrate. Especially since C_{60} is colored, this coating is seen with the naked eye. Furthermore, the application makes additional references to characteristics of the product that can only be discernible if the material is present in macroscopic amounts. For example, the application describes that the product is a powder (Page 8, Line 25). Furthermore, the application describes the product produced by sublimation of the carbon soot can range from a uniform film to a coating. Obviously, these characteristics can be differentiated if the product was produced in amounts that can be seen with the human eye. It is important to keep in mind that which was not stated, if the products produced can only be detected through instrumentation, such representation would have been made in the application and evidence supporting same such as electron micrographs would have been provided. The fact that such statements were not made and such evidence was not provided is further evidence that the products were formed in macroscopic amounts. Moreover, attention is directed to the Kroto Declaration, Paragraphs 14, 15 which he attests that the application describes the method for making macroscopic amounts

of fullerenes and that the inventors had in their possession at the time of the filing of the application macroscopic amounts of fullerenes. Based upon this evidence, it is clear that the applicants had in their possession at the time of the filing, macroscopic amounts of fullerenes.

It is to be noted however that the Office Action has dismissed summarily the facts in the Kroto Declaration, characterizing them as opinion. This is improper, See, in re Alton, __ F. 3d __, 37 U.S.P.Q. 2d 1578, 1583 (Fed. Cir. 1996). First the Office Action has mischaracterized the declaration. Applicants respectfully submit that the U.S.P.T.O. has erred by mistaking a question of fact for a question of law. The Kroto Declaration is not an opinion but is offering factual evidence. Id. Further, the declaration is offering factual evidence in an attempt to explain why, inter alia, the application adequately provides a written description of the subject matter that is claimed. As such, it is to be given weight along with the other evidence in the record on these issues of compliance with 35 U.S.C. §112. In view of this evidence, Applicants have shifted the burden to the United States Patent and Trademark Office. It is improper for the United States Patent and Trademark Office to summarily reject the conclusion therein without adequate consideration. Id. Since the burden has shifted to the United States Patent and Trademark Office, the United States Patent and Trademark Office cannot dismiss the conclusions therein unless it provides evidence, including affidavits of its own, which is to the contrary. Id. No such evidence was forthcoming. Thus, the United States Patent and Trademark Office did not meet its burden, and the above conclusions, as expressed in the Kroto

Declaration must stand; the application conveys to the skilled artisan that the applicants were in possession of macroscopic amounts of fullerenes, including C₆₀ and C₇₀, at the time of the filing of the application.

Furthermore, applicants submit that summary dismissal by the U.S.P.T.O. of the facts in the Kroto Declaration relating to this adequate explanation is improper, for the reasons given hereinabove. The burden has shifted to the U.S.P.T.O., which can only be discharged by presenting evidence or reasons why persons skilled in the art would not consider the application enabling. This, the Office Action has failed to do.

Thus, the application fully complies with the description requirement of 35 U.S.C. §112, first paragraph.

In addition, the specification fully complies with the enablement requirement of 35 U.S.C. §112, first paragraph, and adequately teaches one skilled in the art how to make the claimed invention without an undue amount of experimentation. The specification provides the general teaching to the skilled artisan of how to prepare fullerenes. Although it provides detail, in particular, with respect to two species, the preparation of other fullerenes can be practiced by the skilled artisan utilizing the methodology therein by modifying the parameters without an undue amount of experimentation. Attention is again directed to the Declaration of Kroto, paragraphs 3, 8 and 15, wherein he attests that the application adequately describes how to make fullerenes, including C₆₀ and C₇₀, in macroscopic amounts. Contrary to the allegations in the Office Action, the law does not require the applicant to

describe in their specification every conceivable embodiment of the invention. US v. Teleelectronics, 857 F.2d 778, 786, 8 USPQ 2d 1217, 1222 (Fed. Cir. 1988) (citing SRI Int'l v. Matsushita Elec. Corp. of America, 775 F.2d 1107, 1121, 227 USPQ 577, 586 (Fed. Cir. 1985)). The specification provides exemplification which adequately teaches to the skilled artisan how to make fullerenes, caged molecules consisting solely of carbon atoms, allotropes of carbon, etc.

In the rejection, the Official Action states that the original language of the specification only supports the production of C₆₀/C₇₀ in quantities sufficient to produce coatings that are 2 microns thick. This amount produced is described in Ex. 1, and is only exemplary of the amount of product that could be produced by the present process. The U.S.P.T.O. is utilizing an engineering issue involving "scaling up" to support its allegation of lack of enablement. This is contrary to case law. There is nothing in the law which requires the applicants to scale up the amount of products prepared by their process. This is an inappropriate basis for supporting an allegation of non-enablement. Moreover, based upon the teachings, the skilled artisan can scale up the amount of product produced without an undue amount of experimentation. For example, if a greater amount of carbon source were used, additional material would have been collected. Moreover, if the exact methodology in Ex. 1 were repeated an infinite amount of times, there can be no question that an infinite amount of material would be collected. Thus, it is absurd for the United States Patent and Trademark Office to state that there application is not enabling for the larger quantities of product to be produced.

Furthermore, applicants submit that the summary dismissal by the U.S.P.T.O. of the facts in the Kroto Declaration relating to this issue without adequate explanation is improper, for the reasons given hereinabove. The burden has shifted to the U.S.P.T.O., which can only be discharged by presenting evidence or reasons why persons skilled in the art would not consider the application enabling. This, the Office Action has failed to do.

Thus, the application is enabling for the subject matter claimed. Therefore, the rejection of the claims under 35 U.S.C. §112, first paragraph, is obviated and withdrawal thereof is respectfully requested.

In support of the rejection of Claims 45, 46, 50, 51, 55, 58, 66, 68-71, 73-74 and 83-84, 160-168, 171-175, 177-178, 181-191 and 195-205 under 35 U.S.C. §102(b), the USPTO cites Huffman et al. in combination with Iijima.

The Huffman et al. reference describes an attempt by the authors to find a model which produces a UV spectrum which matches the UV spectrum of the interstellar extraction curve. Contrary to the allegations in the Office Action, the article is not directed to C₆₀, C₇₀ or fullerenes. The article does not teach or disclose or even claim to teach or disclose that C₆₀, C₇₀ or any other fullerene is produced by the method described therein. In fact, the article does not mention C₆₀, C₇₀ or fullerene at all; the gist of the article is directed to an entirely different subject. Furthermore, there is no evidence of the production of any such products. See Kroto Declaration, paragraph 9. If C₆₀ or other fullerene were produced in macroscopic amounts it would have been noted by the authors. There is no such evidence whatsoever to that effect.

Thus, the reference does not teach the process of making the C₆₀, C₇₀ or other fullerene in appreciable amounts and recovery thereof, as presently claimed. Therefore, the reference does not teach or disclose the claimed process.

In an attempt to overcome the deficiency in Huffman et al., the USPTO cites Iijima to support its unsubstantiated allegation that in view of Iijima, C₆₀ was inherently produced in the Huffman et al. reference.

Iijima discloses a process for evaporating carbon by arc discharge under vacuum between two carbon rods. It alleges that C₆₀ is produced in minute amounts. It is noted that the process disclosed in Iijima is different from that of the Huffman et al. reference. Unlike the present process, in which carbon is vaporized in the presence of an inert gas, the process described in Iijima is performed in a vacuum, i.e., in the absence of any gas. Yet, the USPTO ignores this difference, and asserts that fullerenes are produced when carbon is vaporized by arc discharge in accordance with the description in Huffman et al.

The USPTO has the initial burden of establishing a prima facie case to deny patentability. Ex parte Levy, 17 USPQ 2d 1461, 1463-1464 (Bd. Pat. App. and Int. 1990). In relying upon the theory of inherency, the USPTO must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied art. In re King, 801 F.2d 1324, 231 USPQ 136 (Fed. Cir. 1986).

The USPTO has not met its burden. Although, Iijima alleges that he saw a molecule of C₆₀ in the middle of the carbon particle, the electron micrograph of Figure 1 therein

does not clearly support the formation of C₆₀. His conclusions are in question. As testified by Kroto the conclusion about forming C₆₀ by the process described therein is entirely speculative and unsupported by the evidence. See Kroto Declaration, paragraph 9. It is clear from reading Iijima that he was unable to produce C₆₀ or any other fullerene in any appreciable amounts to characterize the product. Thus, macroscopic amounts have not been made by Iijima. As attested to by Kroto in his Declaration, it cannot be stated with certainty that Iijima produced any C₆₀ at all!

Case law has held that inherency may not be established by possibilities or probabilities; the mere fact that something may result from a given set of circumstances is not sufficient to establish inherency. Continental Can Co., USA Inc. v Monsanto Co., 948 F.2d 1264, 1269, 20 USPQ 1746, 1749 (Fed. Cir. 1991). Inasmuch as the conclusions of Iijima regarding his preparation of C₆₀ are in controversy it cannot be stated with uncertainty that C₆₀ was produced in the Huffman et al. reference. Thus, the doctrine of inherency is not applicable.

Moreover, even assuming, pro arguendo, that the Huffman et al. reference produced C₆₀, it is clear that any C₆₀ that would have been produced was either an accidental prior occurrence or was unwittingly produced that was not recognized until after the discovery described in the present application. Even if that accidental prior occurrence took place, that does not constitute anticipation. Tilghman v. Proctor, 102 US 707 (1881).

The invention claimed by Tilghman in his application was the manufacture of fatty acids and glycerol from fats by

utilizing water at a high temperature and pressure. Prior to the filing of the Tilghman application, there were known processes for making soap and candle making which although incidentally formed fatty acids, were held not to an anticipation of the process of Tilghman.

..... [The prior art] revealed no process for the manufacture of fatty acids. If the acid were accidentally and unwittingly produced, whilst the operators were in pursuit of other and different results without exciting attention and without its even being known what was done or how it had been done, it would be absurd to say this was an anticipation of the Tilghman discovery.

Id., at 711-712.

Therefore, even if some C₆₀ were produced in the Huffman et al. reference, this was not the intent. There was no excitement generated by the reference. If C₆₀ were produced, it was without it ever being known. Therefore, just as in Tilghman, it would be just as absurd to say that the reference was an anticipation.

Moreover, even assuming, pro arguendo, that the logic of the Office Action is accepted, it would still be concluded that Huffman et al., did not produce macroscopic amounts of C₆₀. According to the Office Action, Iijima shows C₆₀ fullerenes formed in a method in which carbon is evaporated by arc discharge, which the Office Action alleges is the method of Huffman et al. If Iijima were an equivalent method, then logic would dictate that the method in Huffman, et al., would inherently produce the same amount of material as that in Iijima, et al. Thus, accordingly, the most that could be

produced by the method described in Huffman et al. would be trace amounts of C₆₀ --not macroscopic amounts, or crystalline product, or sufficient amount of product to produce colored solution when dissolved in benzene as presently claimed.

Moreover, even if C₆₀ were made in the Huffman et al. reference, there was no extraction of same from the soot, as presently claimed. Furthermore, the reference does not specify the pressure of the inert quenching gas, as recited in Claims 204-221 and 223-231. The absence of any one element in the claim negates novelty, Kolster Speedsteel AB v. Crucible Inc., 793 F.2d 1565, 230 USPQ 81 (Fed. Cir. 1986). Thus, for the reasons given herein, the Huffman et al. reference does not anticipate the present invention and thus, the rejection of the claimed subject matter under 35 U.S.C. §102(b) is obviated.

In support of the rejection of the claimed subject matter under 35 U.S.C. §103, the Office Action cites the reference to Huffman et al. in view of Iijima and the Russian patent.

Applicants reiterate the arguments herein with respect to the Huffman et al. reference and Iijima. As stated hereinabove, there was no evidence that any fullerenes were prepared in the Huffman et al. reference. The combination would not teach, disclose or even suggest the preparation of macroscopic amounts of fullerenes, or the separation of same, as presently claimed.

The citation of the Russian patent does not overcome this deficiency.

In the Russian patent, the process is carried out on melts containing carbon and iron, and impregnation is carried out with lanthanoids. According to the reference, the CnLa are

extracted by boiling in toluol. This system is unlike the present system since the carbon soot of the present invention does not contain any metals. Thus, the system as well as the material being extracted in the Russian patent is quite different from the present system, which contains soot comprising fullerenes, e.g. C_{60} . Thus, the goals in the Russian article are to separate C_nLa from the melt, which is quite different from that of the present invention.

As one skilled in the art is well aware, the success of an extraction of a material from a mixture or suspension is dependent upon the substances present therein. If the substances present in one mixture are different from those in another mixture it is not possible to extrapolate the results of one system to another. This is the case of the teachings of the Russian article vis a vis the present invention. More specifically, the Russian patent fails to teach, disclose or suggest that fullerene, e.g., C_{60} , is being separated or extracted from a soot, as presently claimed. There is nothing therein to suggest that non-polar solvents could separate C_{60} or fullerenes from the soot. The reference discloses the extraction of C_nLa from an entirely different material. There is nothing in the prior art that equates the conditions in the Russian patent with the conditions in the present invention. Thus, even if the C_nLa is soluble in toluol, there is nothing in the Russian patent that would suggest that the fullerenes, e.g., C_{60} , produced in the present invention could be extracted from the sooty product by the use of non-polar solvents. It is to be remembered that solubility of a product in a solvent is one of several factors to be considered for separations, e.g., one must also consider, inter alia the solubility of the other

components in the mixture in the solvent. Since this was the first time that anyone had prepared fullerenes, e.g., C₆₀, there was no way of determining, a priori; whether the other products in the soot would also be soluble in benzene toluene or other non-polar solvent or the effectiveness of the separation of the C₆₀ from the soot using same. Thus, even assuming, pro arguendo, that the Russian patent could be used as a reference to suggest that C₆₀ would be soluble in a non-polar solvent, there is nothing therein that would suggest that the C₆₀, or fullerenes could be separated from the soot by utilizing a non-polar solvent, as presently claimed.

Furthermore, even if the teachings of the references were combined as suggested by the Office Action, and assuming that Iijima teaches the preparation of trace amounts of C₆₀ by an equivalent method of Huffman, et al. the most that could be stated from the combination is that a trace amount of C₆₀ is produced in Huffman, et al., -- and not macroscopic amounts, as presently claimed.

With respect to the sublimation step, the Official Action states that it is well known to sublime organic soluble species to purify them and thus it alleges that it would have been obvious to sublime fullerenes from the soot or toluene extracted material of the references.

But even assuming, pro arguendo, that the present process utilizes a known scientific principle, as alleged by the Office Action, that alone does not make the process obvious. Uniroyal Inc. v. Rudkin Wiley Corp., 837 F.2d 1044, 5 USPQ 2d 1434 (Fed. Cir. 1988). There is no suggestion in any of the references to make fullerenes from the vaporization of a

carbon source in an inert gas, and separation thereof, as claimed. Thus a prima facie case has not been made.

It appears that the United States Patent and Trademark Office has based its rejection on hindsight. It is important to remember that the inventors were recovering fullerenes for the first time. A priori, it was not known whether non-polar solvents or sublimation would have been useful to separate the fullerenes from the soot. There is nothing in the prior art to suggest that the teachings in the Russian patent are applicable to the present system. It is submitted that the Office Action reconstructed the present invention from the prior art by using the claims as blueprints. This is impermissible under 35 U.S.C. §103. Interconnect Planning Corp. v. Feil, 774 F.2d 1132, 227 USPQ 543 (Fed. Cir. 1985). There is no motivation to combine the references as the Office Action has done.

Moreover, the USPTO has also ignored the obvious. If the present process was so obvious, as alleged by the USPTO, why did it take until 1990, 17 years after the publication of the Huffman et al. reference to find the proper methodology to prepare fullerenes, e.g. C₆₀ or C₇₀? The only explanation is that the present process is not obvious.

It is important to remember that the discovery of Huffman and Kruschmer for the formation of fullerenes described in the application fulfilled a long felt need. As described in Paragraphs 11 and 12 of the Kroto Declaration, after the initial detection of C₆₀ by the Smalley and Kroto groups, attempts were tried by many experts in the field for five long years to prepare fullerenes on a larger scale, but all were unsuccessful until Huffman and Kruschmer developed

the methodology described in the present application. This is further emphasized by the Smalley group in the article entitled "Fullerene" by Robert F. Curl and Richard Smalley printed in Scientific American 1991, pp. 54-62.

Thus, for five years, we had been searching for a method of producing visible amounts of the stuff. We call our efforts "the search for the vial" because quantum calculations for such a soccer ball shaped carbon molecule suggested it would absorb light strongly only in the far violet of the spectrum....
Curl, et al. at 55.

Furthermore, the preparation of the material in larger amounts was not trivial; other scientists in the field were also unsuccessful:

...We were not alone. Our initial "soccer ball" proposal published in Nature in 1985 had made the quest one of the hottest in chemistry.

In our laboratory we collected the sooty carbon produced by the vaporization laser while using various chemical techniques to detect the presence of C_{60} . We slurried the soot in benzene, for example, and looked for a yellow color. But, the solution in our test tubes stayed clear, with boring black soot sitting on the bottom. The community of cluster chemists ran many more sophisticated experiments but achieved no better result.

Many gave up hope of ever seeing the yellow vial. They reasoned that although the fullerenes may be stable, it was too hard to separate them from the other sooty material

being produced in the vaporization experiments. Perhaps, the workers said some dedicated chemist might one day extract a few micrograms with some special solvent, but no one seriously expected C₆₀ to be available in bulk anytime soon. Id at 55-56.

Thus, even armed with the teachings of the cited references, no one in the "hottest quest in chemistry" was able to make macroscopic amounts of fullerenes including C₆₀, until the present inventors had found the proper methodology, as described and claimed in the present application.

Inasmuch as the present inventors have fulfilled a long felt need, this is cogent evidence that the claimed invention is unobvious. In re Dow Chemical Company, 837 F.2d 469, 5 USPQ 2d 1529 (Fed. Cir. 1988).

Therefore, the rejection of the claimed subject matter under 35 U.S.C. §103 is obviated and withdrawal thereof is respectfully requested.

In support of the rejections of Claims 45-54, 57, 62, 63, 76-80, 83-84, 160-163, 169, 179, 180-183, 187-188, 192-193, and 203, the Office Action cites Yoshimura et al., in view of Reck with the Japanese reference cited to show alleged inherent states of fact.

Applicants respectfully submit that Yoshimura is totally unrelated to the present process. More specifically, Yoshimura teaches the production of carbon black from hydrocarbons in a carbon black producing furnace which contains a first zone where an oxygen containing gas and a fuel are mixed to form a high temperature combustion gas and a second zone wherein the high temperature combustion gas flows and

wherein hydrocarbon material is jetted and introduced into the high temperature combustion gas to subject the hydrocarbon to thermal decomposition and or incomplete combustion to form carbon black. This high combustion gas is not a quenching gas for it promotes the combustion or decomposition of the carbon black. In fact, an oxygen containing gas is not a quenching gas. This is in contrast to the present process wherein the carbon source is vaporized in the presence (in an atmosphere) of a quenching gas to help cool the vaporized carbon. Therefore, the use of the combustion gas in Yoshimura et al., teaches away from the use of the inert gas in the present process.

Furthermore, since oxygen is not a quenching gas, it is not present in the present process. This is in contrast to the teachings in the primary reference which requires oxygen. Thus, the teaching in the primary reference is totally irrelevant since the products of the reactions are formed under entirely different conditions.

Moreover, the products formed from the combustion of a hydrocarbon source and the vaporization of carbon in the present process are completely different. The carbon product of the primary reference is an oxidized carbon and is not a graphitic carbon containing fullerenes, as formed in the first step of the present process.

Consequently, Yoshimura et al., do not teach, disclose or even suggest the present process.

Moreover, there is nothing in Yoshimura et al., that suggests that fullerenes, or even C_{60} were found in any amounts, let alone, macroscopic amounts, as presently claimed.

Reck et al., do not overcome the deficiency of the primary reference. This reference discloses a process for removing extractables from carbon blacks in a fluidized bed, wherein low extractable carbon blacks are treated under mild temperature conditions (320°C) with an oxygen containing gas and high extractable carbon blacks are treated first at 100°-320°C with steam and then at 200-500°C with an oxygen containing gas. As indicated hereinabove, it suggests the use of oxygen containing gas, for the extraction step, which step is not utilized by the present invention. Reck et al., is limited to the process of removing extractable from carbon black in a fluidized bed. It is completely silent as to the formation of the carbon black, which methodology is different from the graphitic soot of the present invention. Thus, the combination of the two references would suggest in a first step the combustion of a hydrocarbon source in the presence of oxygen i.e., in an atmosphere of a non-quenching gas to form a product different from the graphitic carbon comprising fullerenes, (e.g., C₆₀) of the present invention. Thus, since Reck et al., does not modify this step, the teachings therein is irrelevant for the combination would not teach, disclose or suggest the vaporization of carbon source in the presence of an inert quenching gas to produce a sooty carbon product comprising macroscopic amounts of fullerenes, such as C₆₀, and extracting the C₆₀ from the soot, as presently claimed.

Although, the Japanese reference may teach that a ten-hour Soxhlet extraction of 3 kg of conventional carbon black would yield 5.0 mg of C₆₀, this was published after the filing of the present application and as such is not a reference. However, the Office Action cited it to allegedly

show that C₆₀ is produced via Soxhlet extraction of carbon black with toluene. Even if the teaching therein is true, it is totally irrelevant, since the teachings in secondary reference do not overcome the inadequacies of the primary reference.

Therefore, this rejection of the Claim under 35 U.S.C. §103 is obviated and withdrawal thereof is respectfully requested.

In support of the two rejections of the claimed subject matter under 35 U.S.C. §102(b), the Office Action cited Bacon and Kappler et al. However, as stated in the Kroto Declaration in Paragraph 9, those references do not make any assertion that C₆₀ or C₇₀ or any other fullerene were made, and there is no evidence that fullerenes were made in these disclosures. Despite the deficiency, the USPTO alleges that the two reference inherently make C₆₀.

Applicants reiterate the discussion hereinabove with respect to the Huffman et al. reference, which comments are incorporated herein by reference. There is insufficient evidence for the skilled artisan to conclude that C₆₀ was made in any of these references. As Kroto avers in his Declaration (See paragraph 9 of the Kroto Declaration), it is entirely speculative for anyone to conclude from the teachings in either of the references that C₆₀ or other fullerenes are necessarily present in the products described in the reference. Furthermore, as attested by Kroto, it is not so recognized by persons of ordinary skill in the art. Thus, since it does not necessarily follow that C₆₀ or other fullerene has been produced in either of the articles, the inherency argument set forth by the U.S.P.T.O. is not applicable.

Moreover, even if C₆₀ were made in either or both of these references, it would have been unwittingly made since it was not so recognized. Even if the accidental prior occurrence took place, that does not constitute an anticipation, Tilghman.

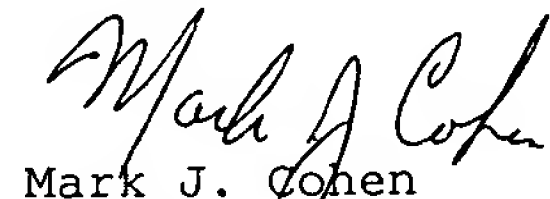
Again, the U.S.P.T.O. has based its rejection on hindsight. It is assumed by the U.S.P.T.O. that C₆₀ was made, without sufficient proof. It is submitted that the Office Action reconstructed the present invention from the prior art by using the claims as blue prints. This is improper.

Furthermore, there is no teaching in these references that the authors necessarily separated any fullerenes, e.g., C₆₀, or that macroscopic amounts were produced and extracted from the soot -- necessary elements of the claimed invention. Thus, the references do not teach every element of the claimed invention.

Therefore, these rejection of the claims under 35 U.S.C. §102(b) is obviated, and withdrawal thereof is respectfully requested.

Thus, in view of the amended claims, and the comments herein, it is respectfully submitted that the present case is in condition for allowance which action is earnestly solicited.

Respectfully submitted,



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